

# (12) UK Patent Application (19) GB (11) 2 095 879 A

(21) Application No 8105383  
(22) Date of filing 20 Feb 1981  
(43) Application published  
6 Oct 1982  
(51) INT CL<sup>2</sup>  
G01D 1/00  
(52) Domestic classification  
G4D 401 411 423 AX  
(56) Documents cited  
GB 1500509  
(58) Field of search  
G4D  
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## (54) Cost display device

(57) Apparatus for providing a consumer with a continuous readout of a cumulative total of the cost of electricity, gas or other metered commodity consumed. Includes a sensor device (2) consisting of a light emitting diode and photo-detector combination or a magnetic sensor which can be fitted into position on the transparent case of the meter to monitor the movement of a dial or wheel on the meter. The sensor

device is coupled to a reader unit (1) that contains a micro computer. This times the interval between successive outputs of the sensor device and from this computes the total amount of a commodity used and using tariff parameters computes the cost. This is then displayed on a numeric display. Other facilities include entering a target consumption figure, monitoring compliance with the target, and assessing the consumption of a single appliance. A bar code reader may be used to update the tariff rates.

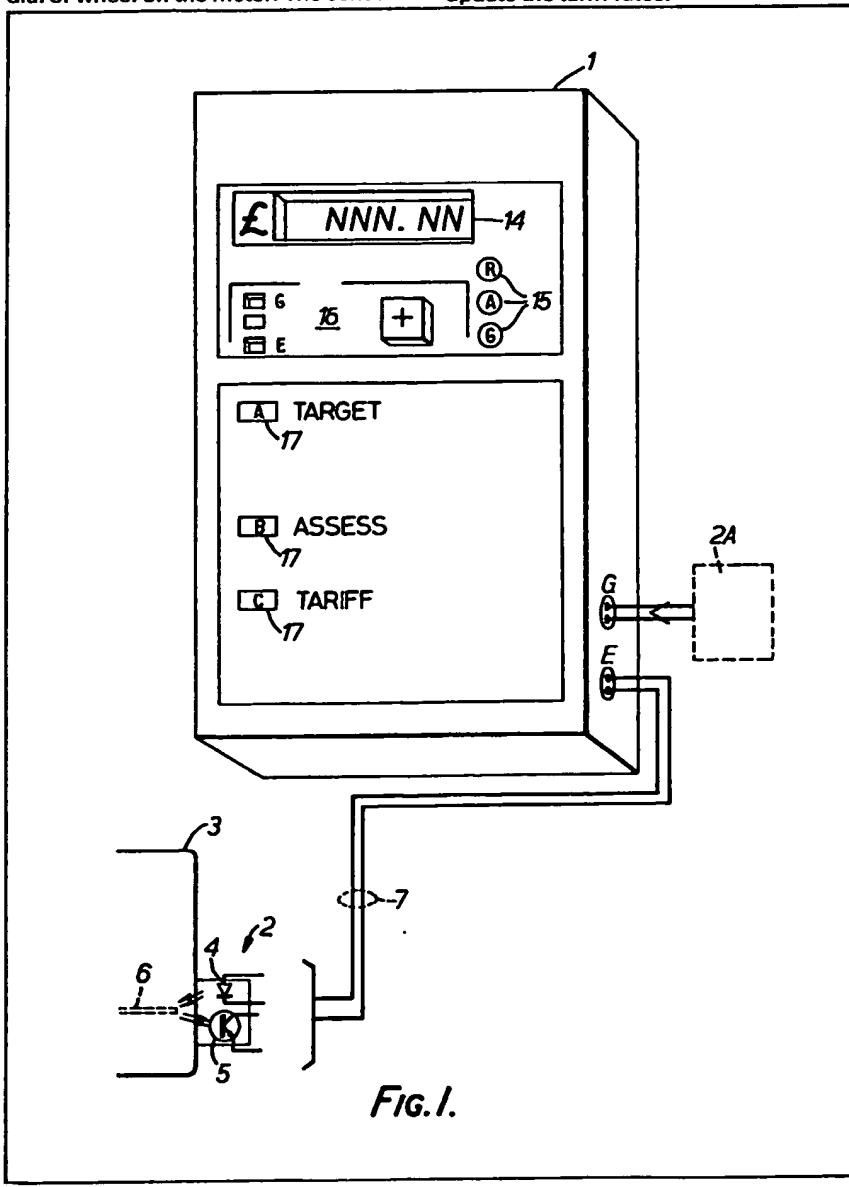


FIG. 1.

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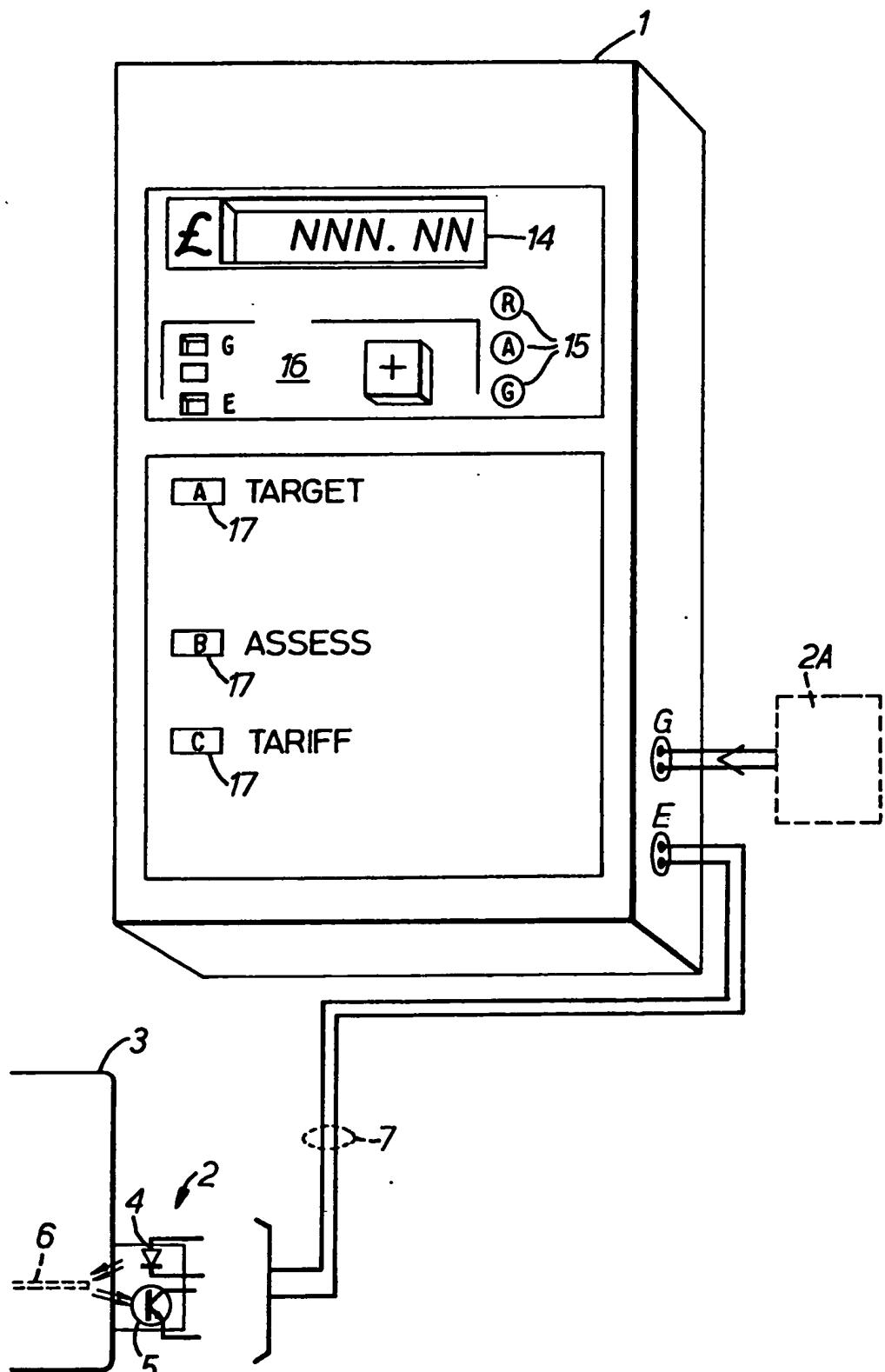


FIG. 1.

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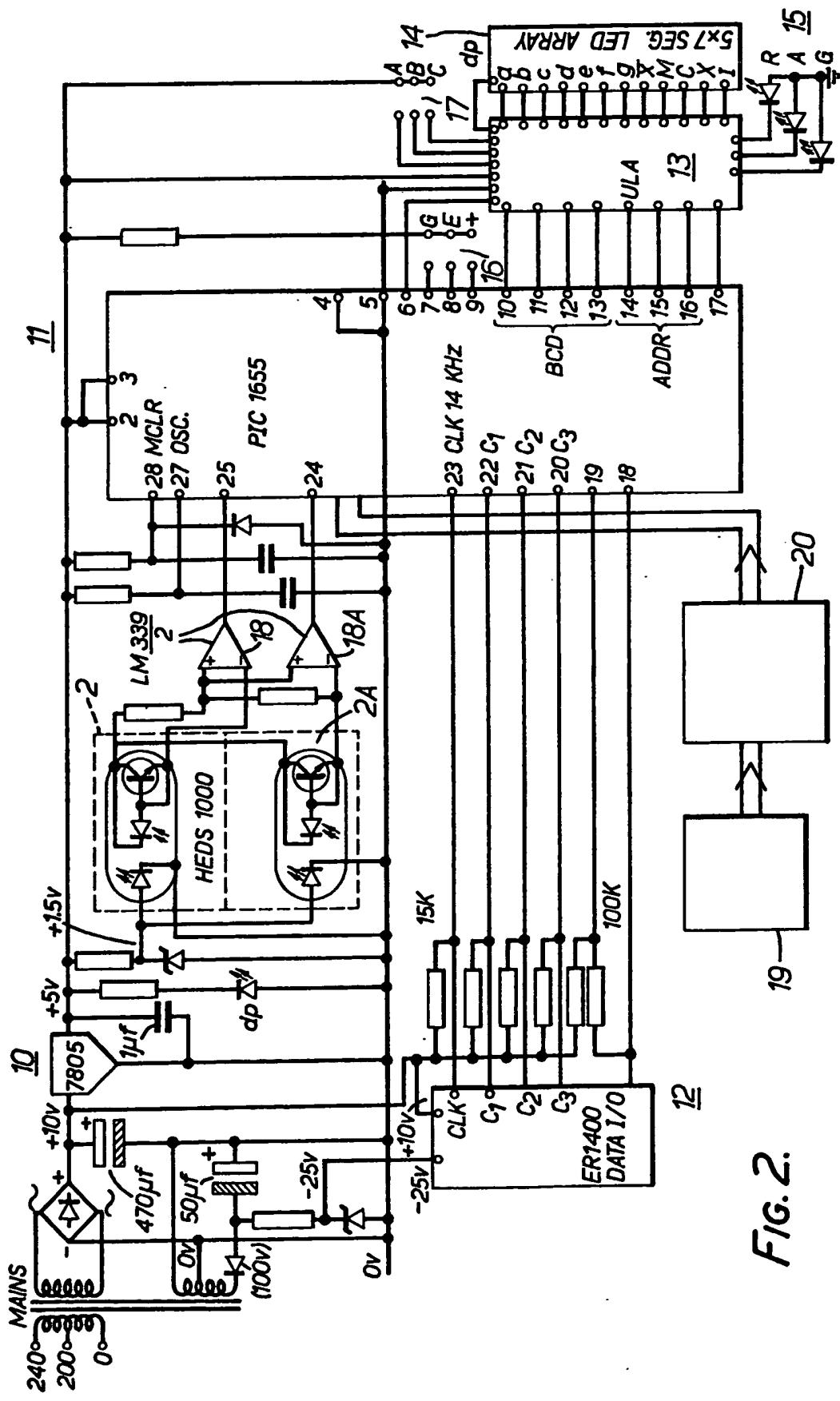


FIG. 2.

**SPECIFICATION****Cost display device**

- 5 This invention relates to a device for displaying the cost of electricity, gas or other metered commodity and is intended particularly but not exclusively to be used as an aid to cost control and conservation of energy.
- 10 Users of gas and electricity (and other utility commodities) are concerned at the high costs of consuming energy both in the home and at work. The government and world authorities recognise the need and encourage users to conserve energy as a scarce resource.
- Few users know how much they spend on energy from day to day. Meters are installed by the supply authorities. Users may assess energy consumption costs only by keeping records of meter readings at 20 points in time, taking differences to give numbers of units consumed in the period of time, applying conversion factors to allow, for example, a calorific value of gas, proportion of standing charges applicable, whether first or second level prices apply and 25 whether minimum or maximum rates apply. Sometimes utility consumer councils send out card calculators. Nevertheless the computation is tedious and beyond the capabilities of some and is rarely done (A representative nationwide survey of domestic consumers - 1979 - revealed that only 25% of respondents actually read their meter and then mostly at random to give a cursory check on the reading recorded on the bill. Only 64% of respondents to the survey had ever tried to read the meter themselves.)
- 30 The survey gives ample evidence of concern at the high costs of energy. About a third of respondents confess to difficulty in paying energy bills. Almost two thirds have taken steps to conserve energy - ranging from buying double glazing (17%), wall insulation (6%), roof insulation (50%), draft excluders (50%) to turning off, turning down or economising generally, whilst some have changed their fuel systems (5%). Eleven per cent use slot meters and 6% more would like slot meters to help them to 35 budget payments, even if it were to cost more. Thirty eight per cent put money aside regularly to pay the bills.
- Both the National Gas Consumers Council and the National Electricity Consumers Council say that 40 consumers need help to control energy costs. University research suggests that the most effective energy conservation measures are those whereby consumers can perceive accruing costs from moment to moment, take action and perceive an 45 associated reduced rate of cost accrual - termed the log pile effect.
- An object of the invention is to produce a practical device for displaying the usage of electricity, gas or other metered commodity.
- 50 According to the invention there is provided apparatus for providing a consumer with an indication of the use of electricity, gas, or other metered commodity including coupling means for coupling the apparatus to an installed consumer's meter and 55 indicator means connected to the coupling means

for providing an indication of the accrued cost of the metered commodity used since a particular time. The coupling means may include a photo-electric sensor or it may include a magnetic sensor for

- 70 example a hall effect device or coil in conjunction with a permanent magnet. The indicating means may include digital display means and timing and calculating means for enabling a continuous readout of cost of the metered commodity, and for providing 75 an indication as to whether the consumer is keeping within a target rate of usage.

Apparatus embodying the invention will now be described by way of example only making reference to the accompanying drawings of which:-

- 80 *Figure 1* shows apparatus embodying the invention, and,

*Figure 2* shows a circuit diagram of the apparatus of *Figure 1*.

- Referring to *Figure 1* the apparatus includes a 85 reader unit 1 and a number of sensor devices one of which is illustrated in detail in *Figure 1* and is designated by the reference numeral 2. The sensor device 2 is shown in position on the glass face of an electricity meter 3. The electricity meter 3 has a wheel 6 which rotates at a rate proportional to the rate of consumption of electricity, this wheel has a mark at one point on its circumference. The sensor device 2 consists of a light emitting diode 4 and a photo-transistor 5. The sensor device is placed on 90 the glass of the electricity meter in such a position that the circumference of the wheel 6 is illuminated by the light emitting diode and thus the passage of the mark can be detected as a change in the electrical output of the photo-detector. An alternative arrangement is that the sensor device is positioned where it can view one of the needles on the dials of the 95 electricity meter. The sensor device thus senses the number of units of electricity being measured by the meter. The device does not obscure any part of the 100 meter such as to impede the task of a meter reader or service engineer and it can be fixed in place with very little skill by the consumer and can be held in place by a strap or sticker. The second sensor 2A shown in *Figure 1* can be similarly attached to view 105 the needle of a gas meter.

The sensor device 2 is coupled to the reader unit by a cable 7 which carries the power for the light emitting diode and conducts the output from the photo-detector.

- 110 *Figure 1* shows the reader unit 1 coupled to two sensor devices 2 and 2A. The timing and calculating functions of the reader unit are performed in a micro

- 115 computer 11 typically type No: PIC 1655 manufactured by Microchip Technology Inc. The reader unit 120 measures approximately 1" x 2½" x 5½". The reader unit takes the output from the sensor unit 2 and by a combination of timing and calculating functions produces a display of the required information. It has various user operable inputs to enable the consumer to choose the information that he wishes to be displayed. The operation 125 of the reader unit will be explained in greater detail below.

*Figure 2* shows the reader unit 1 coupled to two sensor devices 2 and 2A. The timing and calculating functions of the reader unit are performed in a micro 130 computer 11 typically type No: PIC 1655 manufactured by Microchip Technology Inc.

tured by General Instruments Limited which has an associates memory device 12 typically an EPROM type No: ER 1400. The memory device may alternatively be incorporated in the micro computer. Power 5 typically less than 5 watts for the apparatus comes from the domestic means supply via a power supply 10 which produces the necessary supplies for the electronic circuitry.

The micro computer 11 is coupled to a user 10 operable bank of buttons 16. This includes three buttons, one pertaining to data concerning gas consumption (G), one pertaining to electricity consumption (E) and a control switch (+). There is also provided a mechanical linkage enabling both the 15 electricity and gas buttons to be depressed simultaneously. The micro computer 11 is also coupled to a logic array 13 arranged to de-code outputs from the micro-computer 11 into a form suitable for driving a numeric display 14 and three discrete light 20 emitting diodes 15. These light emitting diodes are respectively red, amber and green. The logic array 13 also codes inputs from three further control buttons A, B and C generally designated by numeral 17 in Figure 2. Interfacing with the sensor devices 25 2 and 2a is provided via buffer amplifiers 18 and 18a respectively which may be part of an integrated circuit type No: LM 339.

In operation, at the beginning of a period during 30 which the consumer wishes to monitor the cost of his electricity or gas consumption he enters a budget target amount of money that he estimates he should spend on the particular commodity concerned. To do this, he presses the appropriate gas or 35 electricity button of the buttons 16 and then presses the button A (the target button). This indicates to the computer that a new target amount which may be appropriate to a week or to the normal 13 week quarter, is about to be entered. At this time, a value appears on the display 14 and pressing the + button 40 of buttons 16 causes the amount shown in the display 14 to advance removing pressure from the + button stops this advance, and jabbing the + button advances the figure by one unit at a time. When the desired budget figure is showing in the display the 45 target button A is pressed for a second time. If the display overshoots the desired budget figure pressing the target button for a third time resets the display so that the procedure can be repeated. Once the target figure has been entered the display shows 50 the cost of the energy consumed since the last budget figure was entered. The three lights 15 show continuously whether the consumer is keeping to his target estimate. Illumination of the red light occurs if the rate of consumption exceeds target rate by more 55 than 3½%. The amber light shows if the rate of consumption is within 3½% of the target rate, and the green light shows if the rate of consumption is less than the target by more than 3½%. The consumer can thus see at a glance whether he is within the target. 60 The display 14 can indicate up to a maximum cost of £999.99.

Button B (the Assess Button) enables the user to assess the cost of using a particular appliance. On pressing the assess button B the amber lamp lights, 65 the display clears to zero and the computer records

the background rate of energy consumption over a period of 30 seconds after which the green light is lit. Once this has happened the user may switch on the appliance to be assessed for a period of time at the

70 user's discretion. During this measuring period the display shows only the cost of energy consumed additional to the background rate. (Clearly, if some other equipment such as a refrigerator or central heating system starts up during the test period this 75 will disturb the assessment of the running cost of the appliance under test). The measurement period is terminated by pressing the assessed button B a second time. The computer then calculates the hourly running cost of the appliance and displays the 80 result for two periods of 7 seconds before reverting to the normal display mode. The amber light is lit when the assessed cost is being displayed.

It is also envisaged that the actual meter reading 85 could be entered into the reader unit. This could be done by an official of the utility authority using a secret code procedure. The actual meter reading in the device could then be updated regularly and could be used for telemetry for remote reading or local at-site billing. The legal meter would, of course, 90 remain as the authoritative record of actual consumption and periodic random checks could verify that the device remained in step with the legal meter. In such a use of the device a standby power supply would be required to maintain continuity of gas 95 meter recordings.

In order for the micro computer 11 to be able to calculate the cost of the commodity being used it has to contain tariff parameters relating to the commodity concerned. These parameters change from time to 100 time and consequently it is necessary to update the computer memory. This is done using a strip of paper bearing a conventional bar code. This strip of paper may be supplied to the user by the commodity supplying authority for example, the Electricity or 105 Gas Board and carries a revised tariff parameters. Figure 2 shows a bar code reader 19 coupled to the micro computer 11 via an inter-face unit 20. The bar code reader 19 is of conventional design and the bar code reader may contain, for example, buffer amplifiers of type No: LM 339. The procedure for entering 110 the new tariff parameters is as follows:-

First of all the button C (the tariff button) is 115 pressed. This warns the micro computer 11 that tariff parameters are about to be entered and causes the red lamp of the lamps 15 to light. The strip of paper bearing the bar code is then passed through the unit 19 repeatedly until two identical readings of the data on it are made. When this occurs the green lamp lights. Pressing the tariff button C a second time 120 enters these new parameters into the memory of the micro computer 11 and the display indicates that the new tariff structure has been entered for example by flashing a particular combination of the lamps 15. During this procedure the measurement of energy 125 consumption may be suspended.

Tariff parameters used in the calculations performed by the micro computer 11 are typically as follows:-

A. Factor code to convert basic measured unit 130 (e.g. ft<sup>3</sup> of gas or k.w.h. of electricity) to the pricing

- unit for the meter - taking account of variables such as calorific value. (5 digits)
- B. Meter standing charge per 13 weeks. (4 digits)
- C. Number of units at standard rate. (2 digits)
- 5 D. Price per unit at standard rate. (4 digits)
- E. Price per unit in excess of those of standard rate. (4 digits)
- F. Surcharge factor, if any. (4 digits)
- G. Factor to which surcharge applies, if any. (1 digit)
- H. Maximum price per unit, if any. (4 digits)
- J. Maximum charge per unit, if any. (4 digits)
- K. Scalar factor. (1 digit)
- L. Rate of VAT. (2 digits)
- 15 M. Factors to which VAT applicable. (1 digit)
- N. Reserved. (14 digits)
- Instead of optical sensor devices as described above the sensor devices may be magnetic. They could consist of hall effect devices and maybe placed
- 20 on the casing of the meter being monitored to detect movement of an internal paddle such as is present in a gas meter. A similar device could be used to monitor flow meter of the type used for district heating or of the type used for monitoring the supply
- 25 of oil to an oil fired heating system. In place of hall effect devices it is envisaged that inductively operated magnetic sensors may be used. It should also be appreciated that any number of sensor devices can be used so that simultaneous monitoring of
- 30 electricity, gas, hot water for district heating and oil can be achieved with a single reader unit. It is also envisaged that commodities other than energy commodities be monitored, for example water.

### 35 CLAIMS

1. Apparatus for providing a consumer with an indication of the use of electricity, gas or other metered commodity including coupling means for
- 40 coupling the apparatus to an installed consumer's meter and indicator means connected to the coupling means for providing an indication of the accrued cost of the metered commodity since a particular time.
- 45 2. Apparatus according to claim 1 wherein the coupling means includes a light source and photodetector.
3. Apparatus according to claim 1 wherein the coupling means includes a magnetic sensor for
- 50 example a hall effect device or coil.
4. Apparatus according to claim 1, 2 or 3 wherein the coupling means is adapted to be able to couple to at least two meters metering separate commodities.
- 55 5. Apparatus according to claim 4 wherein the indicator means provides an indication of the total of all the commodities monitored.
6. Apparatus according to any preceding claim wherein the indicator means is arranged to produce
- 60 an indication of whether the rate of the consumer's consumption of the commodity is within a pre-selected target rate.
7. Apparatus according to claim 6 wherein the compliance with the target rate is displayed using 3 lamps, one of which lights when the consumption is

within a target band, one of which lights when the rate is below the target band and one of which lights when the consumption is above the target band.

8. Apparatus according to claim 7 wherein the target band extends up to 3½% each side of the target rate.
9. Apparatus according to any preceding claim wherein there is provided means for updating tariff parameters in the indicator means including a bar-code reader.
10. Apparatus according to any preceding claim wherein the metered commodity is selected from a group consisting of electricity, gas, water, heat (district heating), oil and coil dust.
- 80 11. Apparatus for providing a consumer with an indication of the use of electricity, gas or other metered commodity substantially as herein described with reference to the accompanying drawings.

Printed for Her Majesty's Stationery Office, by Croydon Printing Company Limited, Croydon, Surrey, 1982.  
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.